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FACULTY OF ENGINEERING AND TECHNOLOGY

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DEPARTMENT OF COMPUTER ENGINEERING

COURSE: CEF 440 - Internet Programming and Mobile Programming

TASK 5: UI design and Implementation of the biometric student's attendance app

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Academic year: 2023-2024

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INTRODUCTION

In the era of digital transformation, the integration of biometric authentication has become increasingly crucial for enhancing security and user experience in mobile applications. This report outlines the User Interface and implementation of the *AttendEase* mobile app that leverages fingerprint biometric authentication to streamline and secure user interactions. The technologies used to build the server-side is React Native with TypeScript, Node.js with Express for the backend, and MongoDB for the database. This combination of technologies ensures a robust, scalable, and efficient system. The report details the system architecture, and frontend development, and the integration of fingerprint biometric authentication, providing a comprehensive view of the mobile app(UI) and an overview of the technical considerations and decisions made during the development process.

1. USER INTERFACE (UI) DESIGN

1.1.   Design Principles

Design principles are some principles that we must follow in other to get a better design, without focusing the main objective on user's needs. They are foundational guidelines that drive the creation of user interfaces (UI) to ensure they are effective, efficient, and satisfying for users. When developing a biometric student attendance mobile application, these principles become even more critical. This application needs to seamlessly integrate biometric technology while providing an intuitive and accessible interface for students, lecturers, and administrators. Some best practices design principles that uses our mobile application are:

1.1.1. User-Centered Design

The core of user-centered design is understanding and prioritizing the needs, preferences, and limitations of the end-users. For our application, this means creating an interface that is intuitive for students marking their attendance, straightforward for lecturers managing attendance data, and efficient for administrators overseeing the system. Continuous user feedback and testing are integral to refining the UI to meet these diverse needs effectively.

1.1.2. Modular design

It is an approach used to design various products or applications, by breaking it down into separate or independent parts or components. To use this in our application, we divided the application into many components, that is, we design the components first before building the whole pages at the implementation phase, it is the bottom-up approach!! We have components like navigation, input, button, form component, card, and notification. From the image below, we can see different components we used in our application:
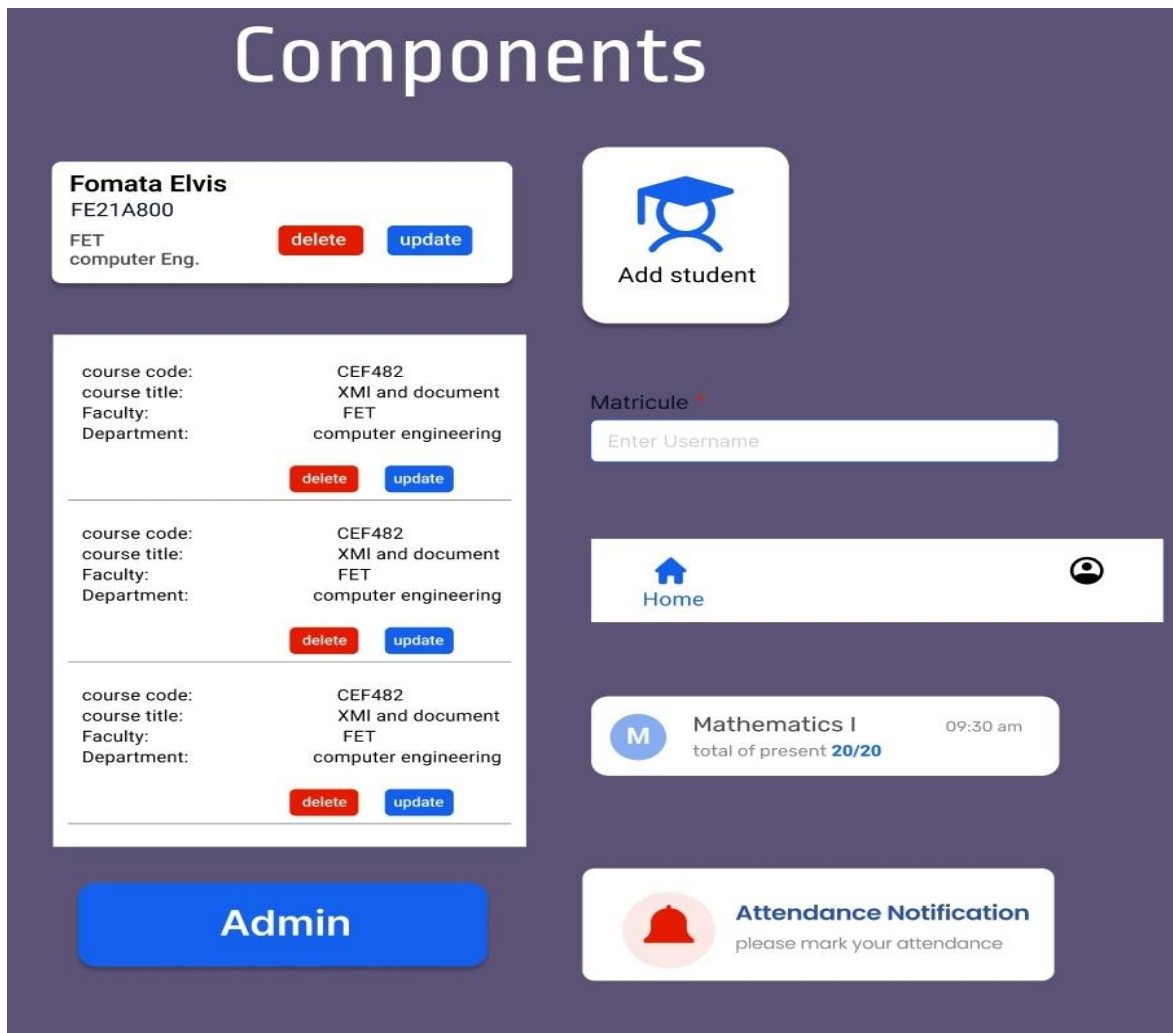
1.1.3. Consistency

Consistency in UI elements and interactions is crucial for creating a seamless user experience. This involves maintaining uniformity in design components such as buttons, icons, fonts, and colors throughout the application. Consistent navigation patterns and terminology also help users predict how the application will behave, reducing learning time and errors. It is applied by:

- **Uniform elements:** We used consistent color schemes, fonts, and button styles throughout the app to create a cohesive look and feel.

- **Predictable interactions:** We ensured that similar actions produce similar results across different parts of the app.

- **The choice of the colors**: it is not done hazardously, we have a couple of rules that based on them. For our design, we made use of many colors, which are more detailed as follows:

✓ Gray-blue (#EDF4FD): This is the main background color, and it express the peace, comfort, and professionalism when using our mobile application. We can see this in the welcome page of the app:

✓ White (#FFFFFF): This is used for purity and cleanness of our labels, neutrality of information, and innocence of looks. This can clearly be seen in the course registration student page bellow.
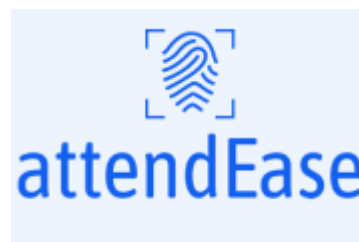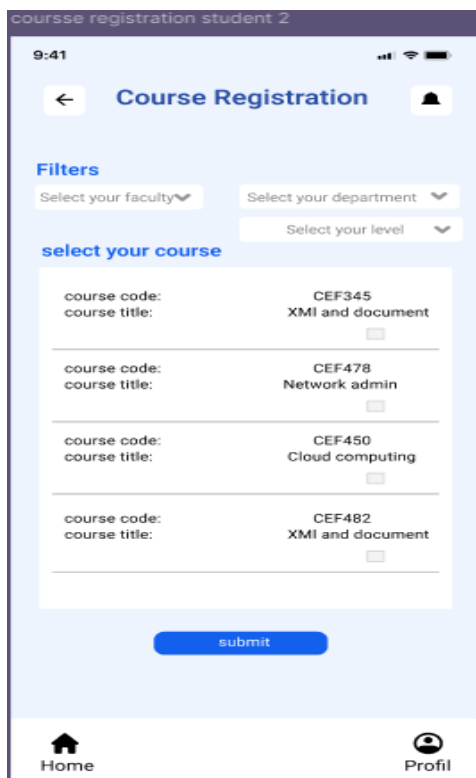
✓ <u>Blue (#1360EE)</u>: This is used in buttons for secureness, trust and calmness when clicking on it. It conveys a sense of technology and innovation. It is the primary color in most of our components and helps students to create their accounts and scan their finger in a safety way.
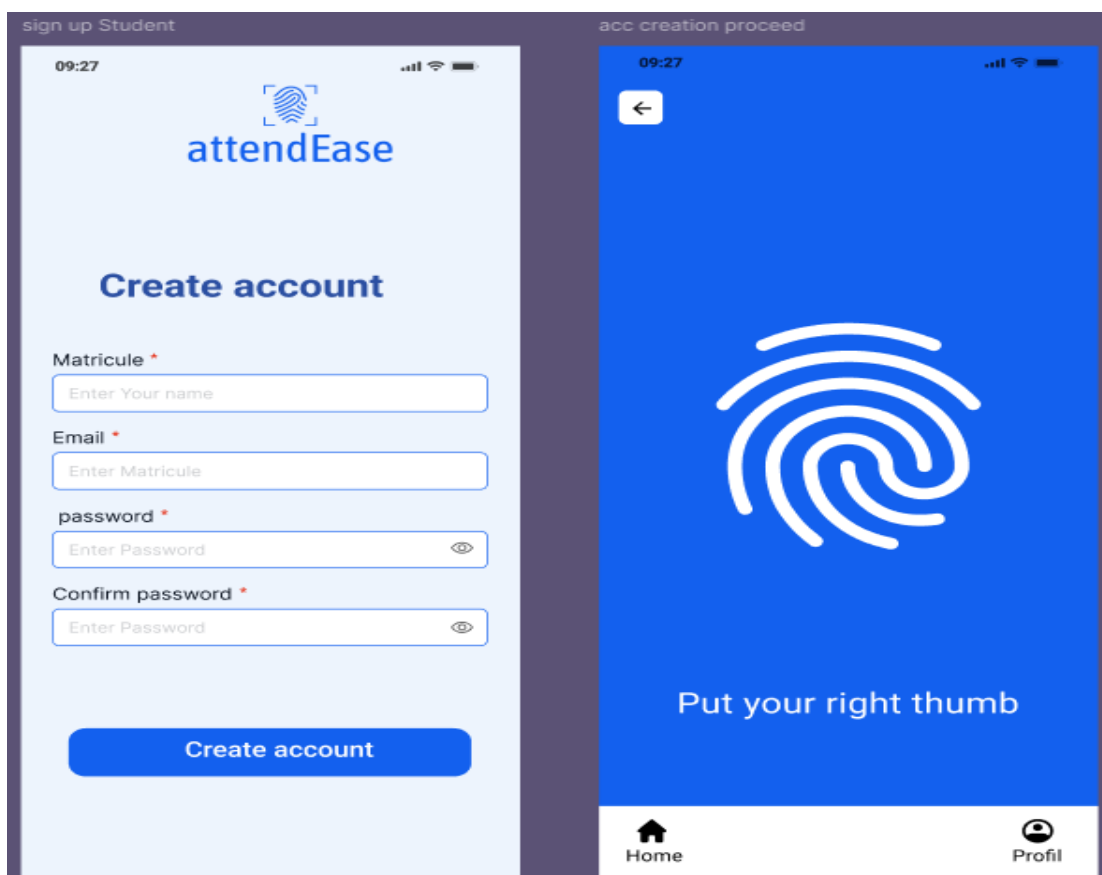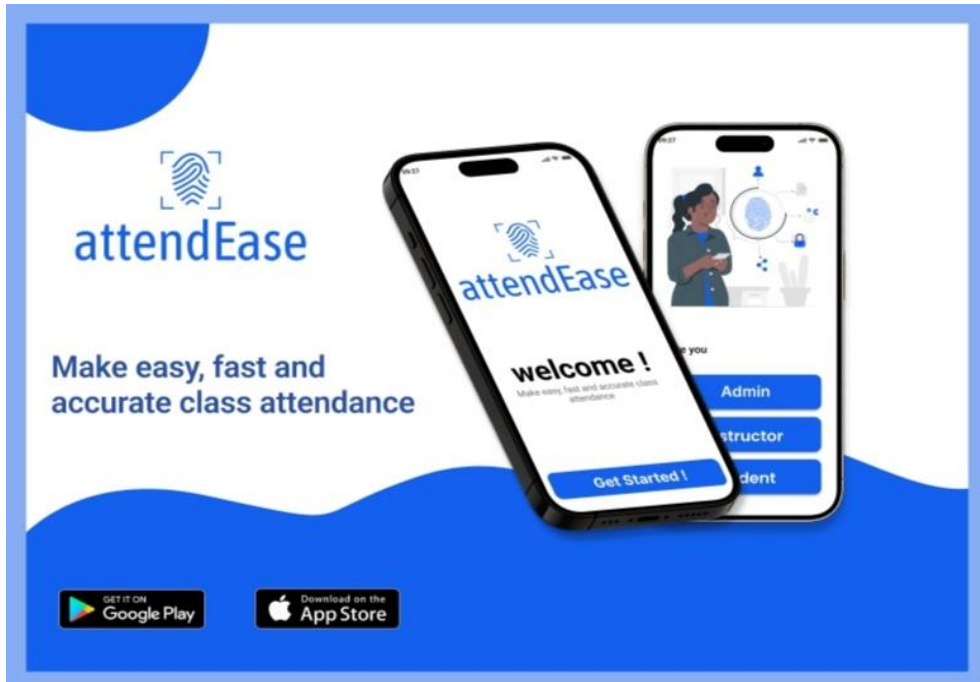
✓ <u>Green</u>: Used in the application for confirmation messages when successfully accomplish something. It conveys success, positivity and assurance. This can be shown in the image below:
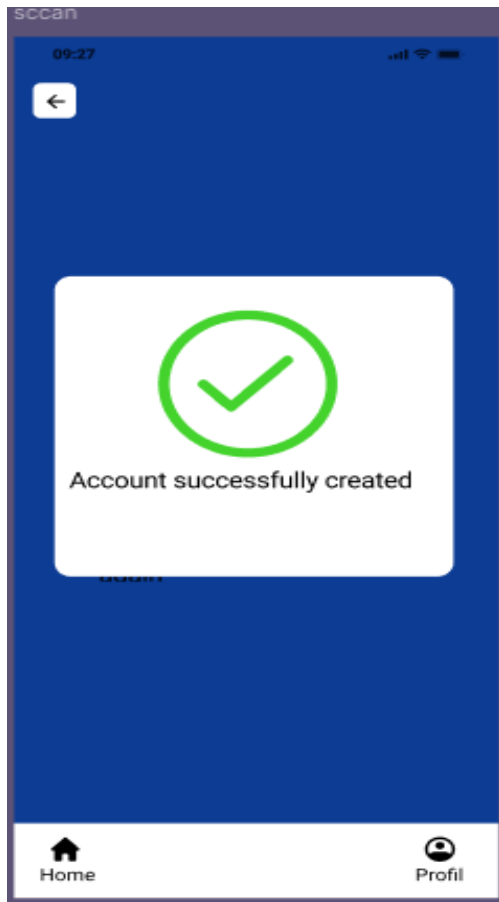
✓ <u>Red (#E51B00)</u>: Used for danger, missing notification (not read), to let user aware of a dangerous action they are going to do in the application.

✓ <u>Black (#000)</u>: Elegance and power of text in the app.

1.1.4. Accessibility

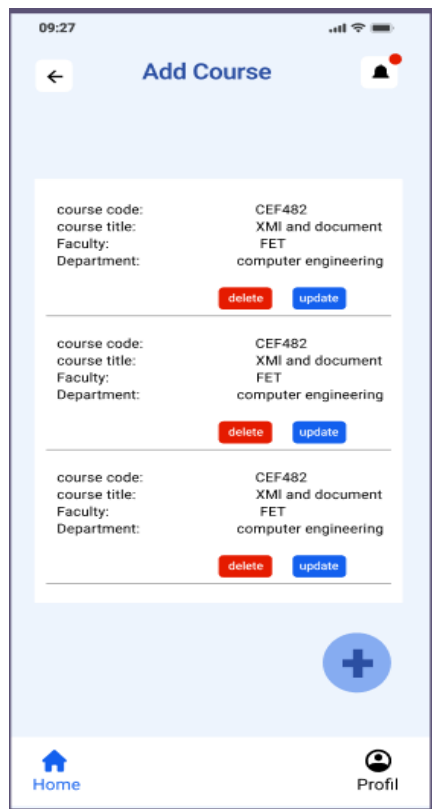It is a fundamental design principle for our application. This involves adhering to accessibility standards such as providing text alternatives for non-text content, ensuring sufficient color contrast, and supporting screen readers. Features like adjustable text sizes and voice commands can further enhance accessibility, making the application usable by a wider audience. It includes:

- **Inclusive Design:** To make sure the app is usable by people with various disabilities. Use appropriate color contrasts (like when a button is clickable or not), provide text alternatives for non-text content, and ensure compatibility with screen readers.
- **Scalability:** To design the interface to be responsive and work on different devices and screen sizes.

1.1.5. Feedback and Responsiveness

These actions are essential in a biometric application. Users should receive confirmation when their attendance is successfully recorded or if there is an error in the fingerprint recognition

process. Visual and auditory feedback can enhance user confidence and guide them through the necessary steps to complete tasks. It includes:

- **Instant Feedback:** We have provided immediate feedback for user actions, such as button presses or form submissions, to confirm that their input has been received, fingerprint scanned successfully, course successfully registered, etc.
- **Loading Indicators:** We used them to inform users that a process is ongoing and to prevent them from thinking the app has frozen, that's important!

1.1.6. Security and Privacy

Given the sensitive nature of biometric data, the application must prioritize security and privacy in its design. Users should be informed about how their data is used and protected, fostering trust in the system. This includes:

- **Data Encryption:** Protect sensitive biometric data with strong encryption methods. Collecting the fingerprint of a student is so sensitive in the way that it can be used to unlock personal vault, devices, etc... That's why it should be encrypted, and it is the hash function that should be stored.
- **User Consent:** Clearly inform users about data collection practices and obtain their consent through the privacy, also terms and condition.
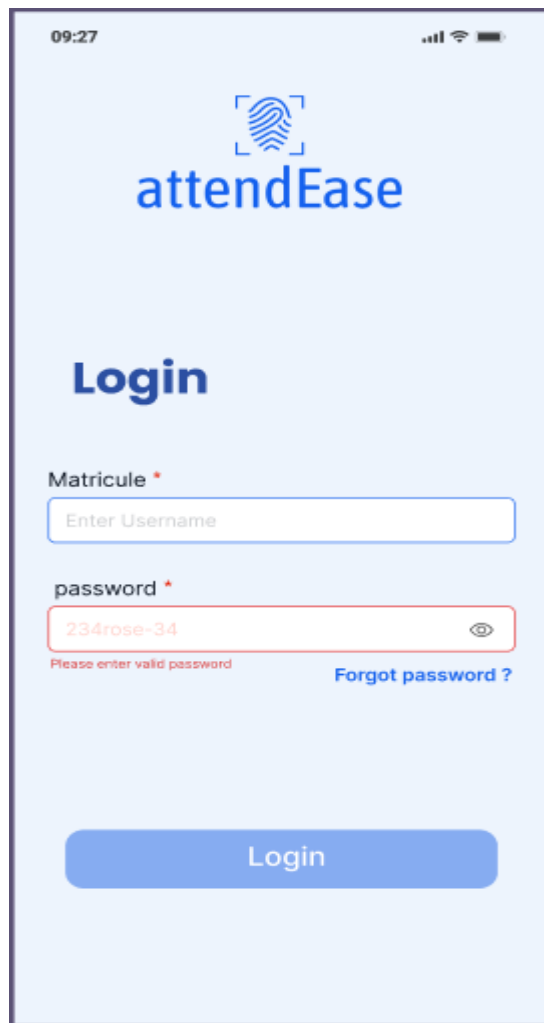
1.1.7. Error Prevention and Handling

- **Prevent Errors:** We designed the UI to minimize the chances of user errors. For example, by using input masks for date or time fields.
- **Graceful Error Handling:** Provide clear, concise error messages and offer solutions to help users recover from errors.
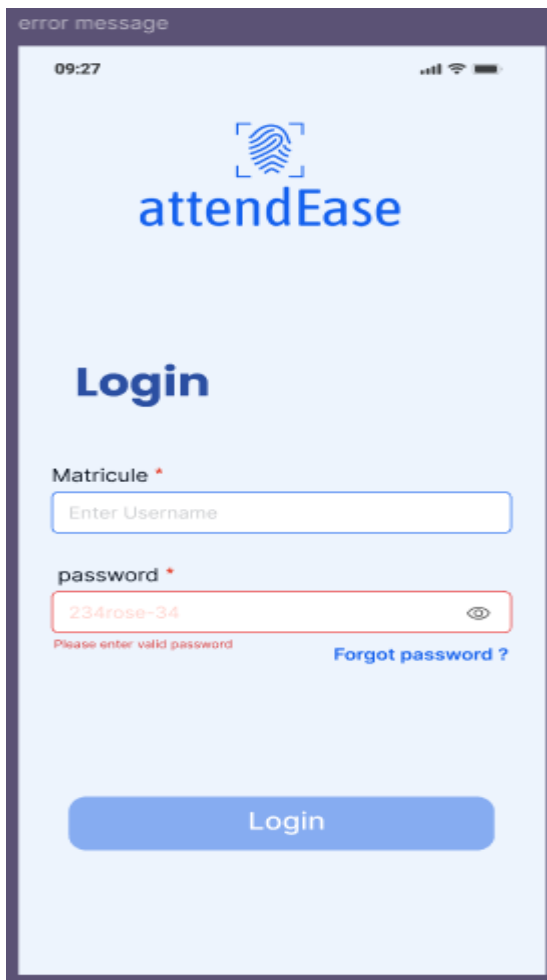
1.1.8. Visual Design

It plays a critical role in shaping the user experience of the application. A well-executed visual design not only enhances usability but also ensures that the application is engaging and easy to navigate. Here are the key considerations and principles for the visual design of the application:

- **Visual Hierarchy**: In our application, we are applying the hierarchy of who come first and who need to be read/seen the first (Welcome page, choose of who you are second, login next, alternative sign up, etc)? Use size, color, and placement to create a clear visual hierarchy, guiding users' attention to the most important elements first.

- **Unity design**: It is to show how well the elements of the design work together, example of using grid and flex for styling

- **Dominance** : Places importance on available content. Dominance is achieved by making the title object larger or more contrasted in the welcome page, reduce contrast when there is an on clickable button, etc.

- **Rhythm**: This is made by visible patterns in terms of shapes, batches of text, background, images, colours, patterns, etc.

- **Alignment**: Here we make use of center elements, left, right, flex, grid, etc.
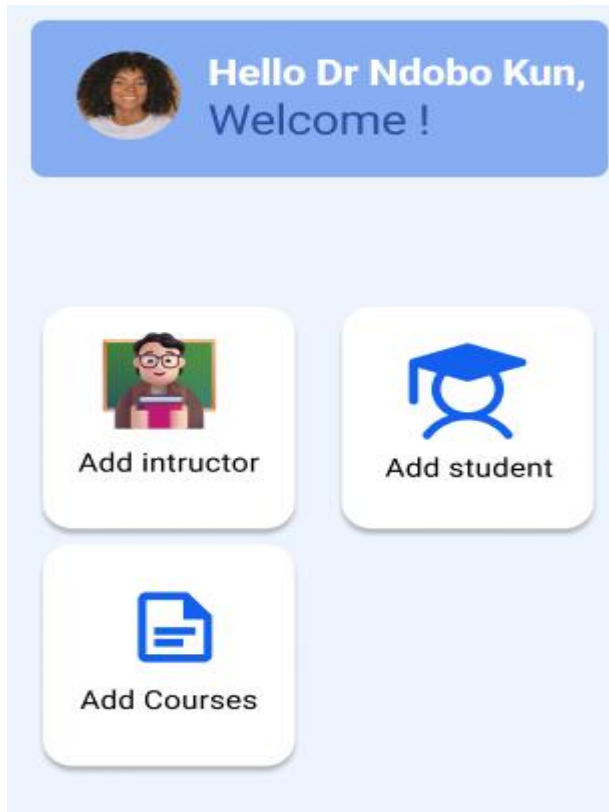
- Gestalt: uniform design
- Balance: line spacing, gap, crop, etc.

Incorporating these design principles helps ensure that the *AttendEase* biometric student attendance app is user-friendly, efficient, and secure. By focusing on the needs of the users and adhering to best practices in UI design, we can create an app that enhances the overall experience for students, teachers, and administrators alike.

1.2. UI design mock-ups and prototypes process

Creating UI design mock-ups and prototypes is a crucial step in the design process. This helps in visualizing the app's interface and interactions before actual development begins. To achieve this, we used the collaborative interface design tool figma. Here's a detailed overview of how to approach this using Figma:

➤ Setting up the project in Figma

- Project Organization: We start by creating a new project in Figma and organizing it into sections or pages for different parts of the application (e.g., login, registration, attendance marking, attendance reports).
- Artboards: We create artboards for each screen of the application. Figma provides predefined sizes for various devices, ensuring that your designs fit the target screens correctly.

➢ Creating UI Mock-ups

- Wireframes: We begin with low-fidelity wireframes to outline the basic layout and structure of each screen. Focus on placement of elements like buttons, input fields, and navigation menus.
- High-Fidelity Designs: Once the wireframes are approved, we move on to high-fidelity mock-ups. This involves adding colors, typography, images, icons, and other visual elements and ensure that the designs align with the branding and visual design principles.

➢ Prototyping Interactions

- Linking Screens: We use Figma's prototyping feature to link different screens and create interactive flows. For example, link the login button to the home screen, the registration button to the registration form, etc.
- Transitions and Animations: We add transitions and animations to simulate the user experience. This can include animations for screen transitions, button presses, and feedback messages.
- Interactive Elements: We make interactive elements like buttons and input fields functional in the prototype. This helps in testing the usability and flow of the application.

➢ Preparing for Development

- Design Specifications: Once the mock-ups and prototypes are finalized, we use Figma to generate design specifications for the development team. This includes details like colors, font sizes, spacing, and component dimensions.

- Exporting Assets: We export all necessary assets (icons, images, etc.) from Figma in the required formats. Figma's export feature makes it easy to prepare assets for development.

1.3. Key UI Components

1.3.1. Login/Registration Screens

Purpose: Allows users to securely access the app using their credentials or register for a new account.

Features:

- Login Forms:

It is composed of the name/ID/matricule and password fields, with a "Forgot Password" link.
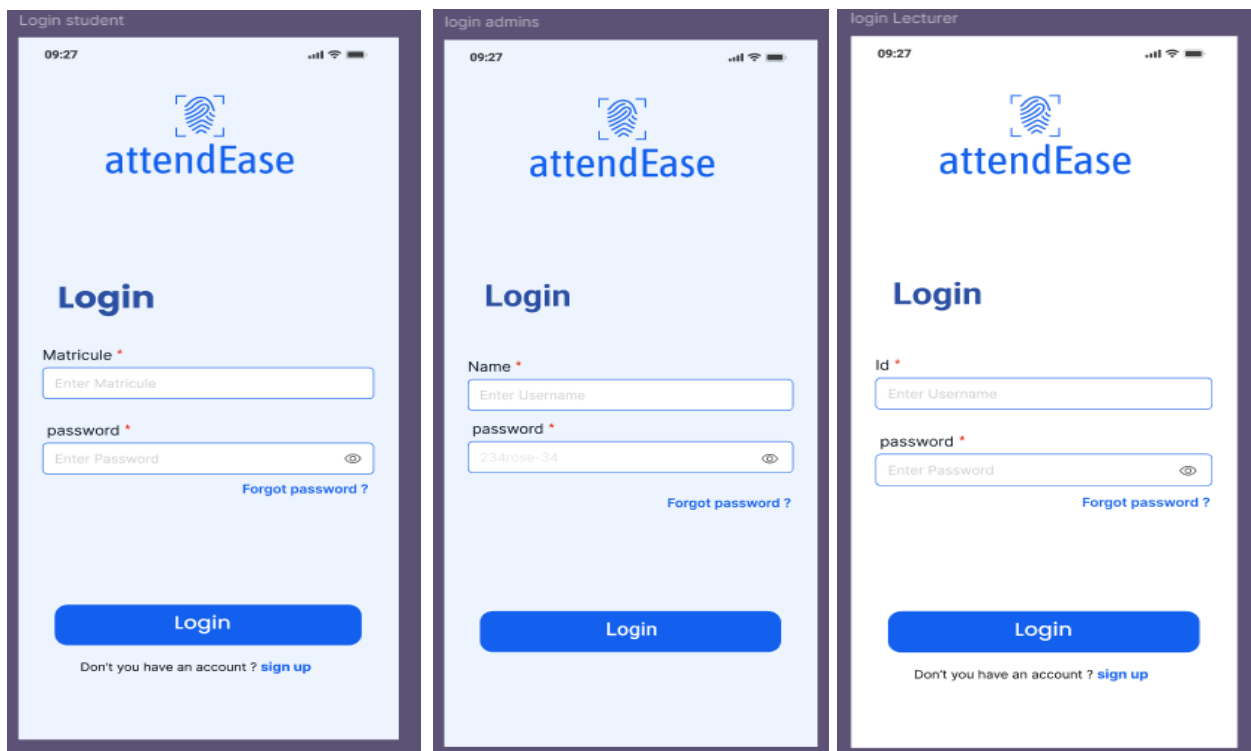
- Registration Form in the platform:

This is fields for personal details, including matricule, email, password, and confirm password for the student, and for the lecturer we have the id which represent his matricule.
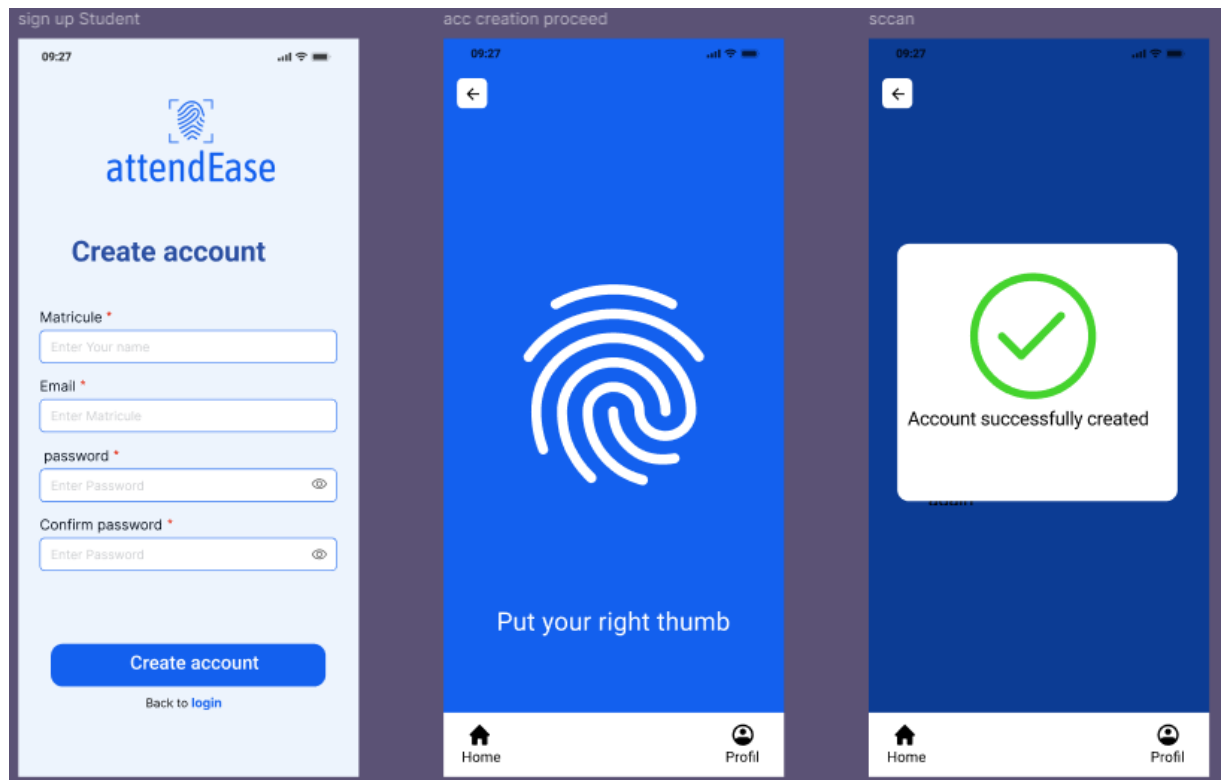
- Registration form in the school:

    This is done by the administrator, where students and lecturers have to send their data from one way to another, and he validates it. He also registers the courses in the application.

1.3.2. Attendance Dashboard

Purpose: Provides an overview of the student's current attendance status.
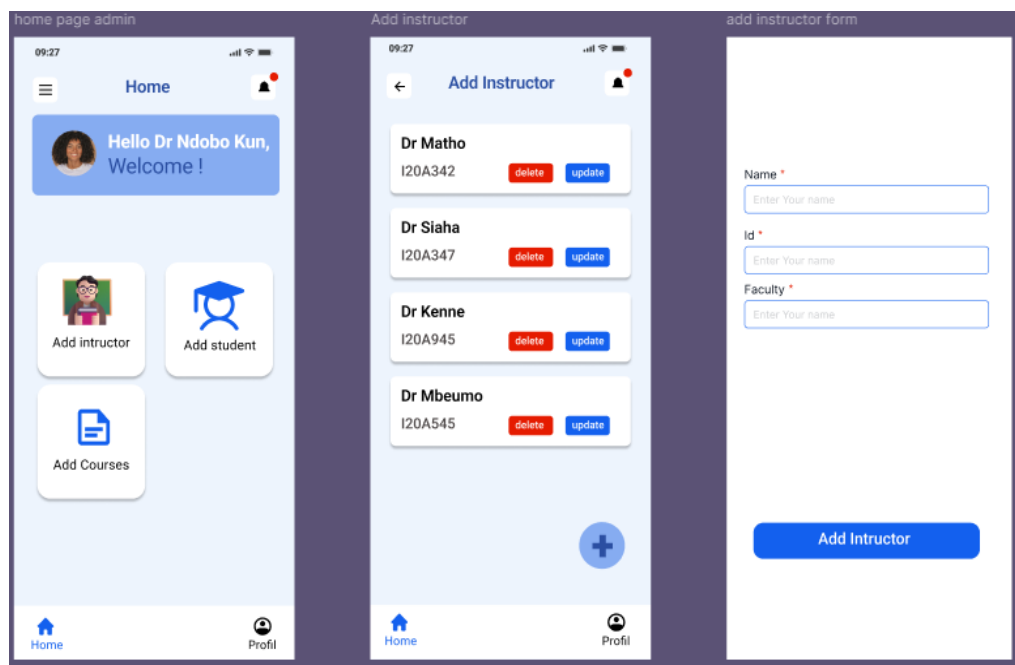
Features:

- Daily Attendance Status (filtered): Visual indicator when you where absent(red) and present (blue)
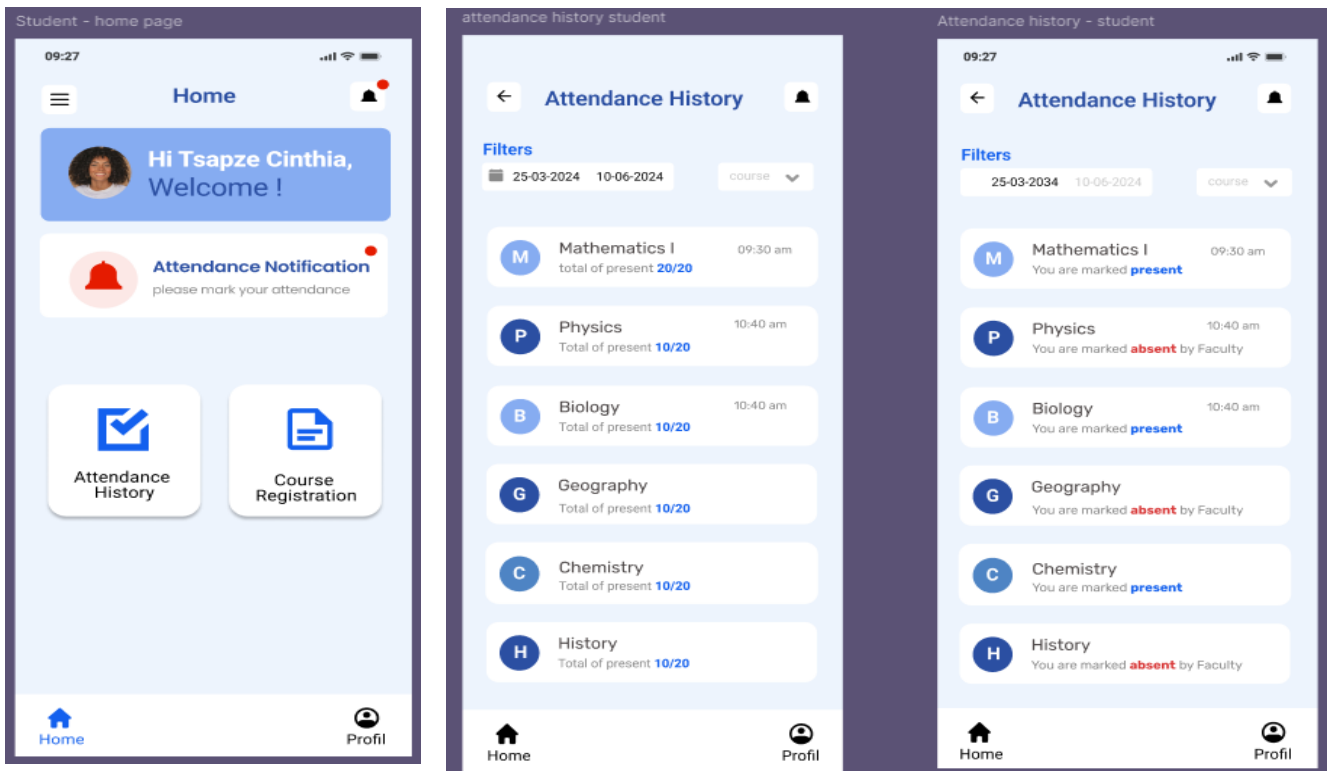
- Quick Links: Buttons for quick access to check-in/check-out, your profile, attendance history and course registration.
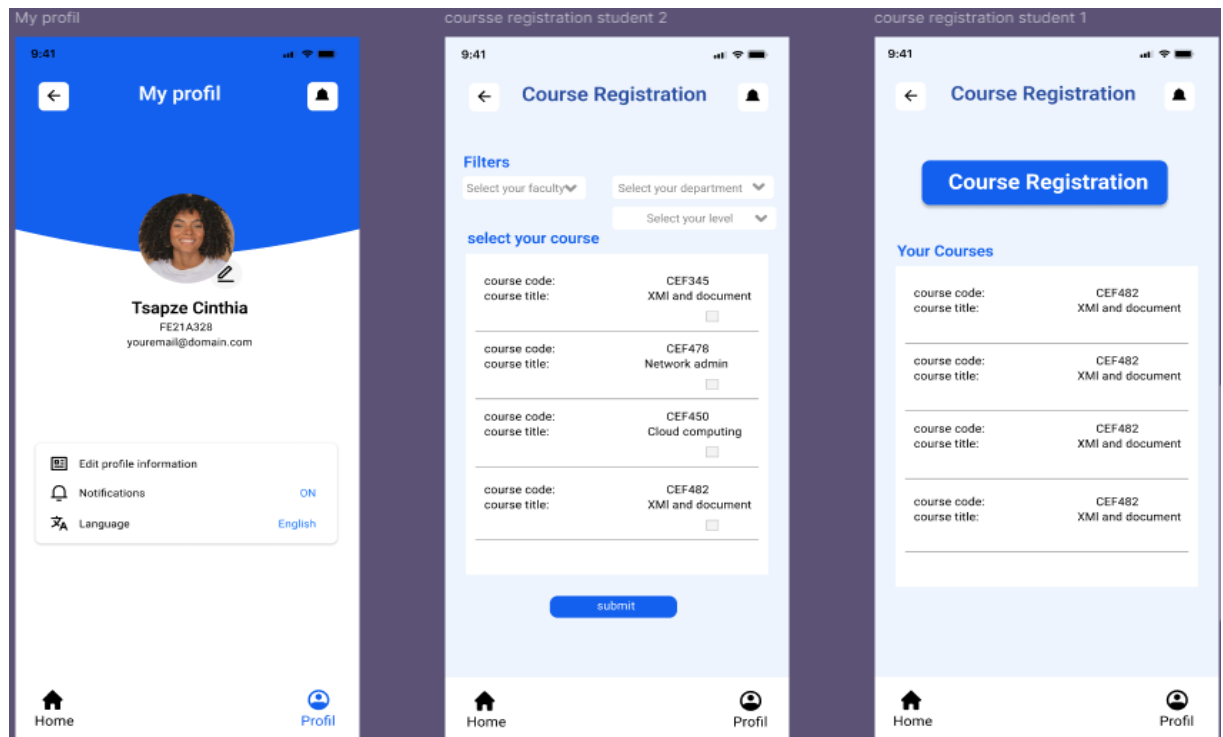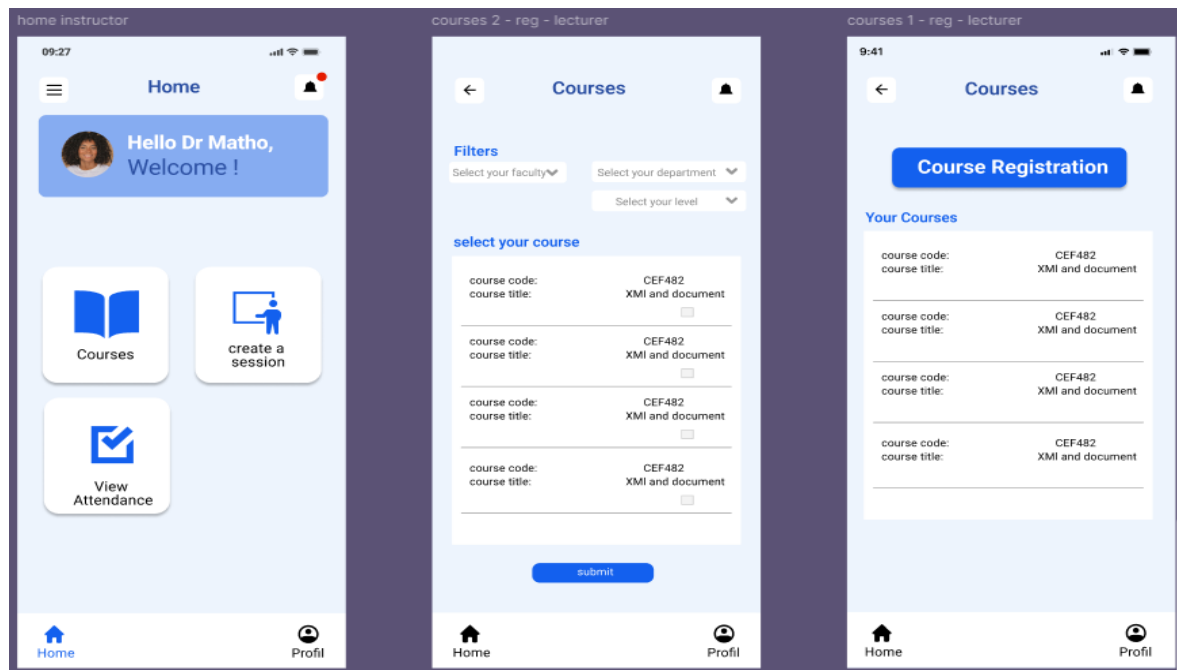
1.3.3. Fingerprint Scanning Interface

Purpose: Facilitates the biometric check-in/check-out process.

Features:

- Fingerprint Scanner and confirmation message: Interface to place the finger and feedback on successful or failed scans on the device's scanner.
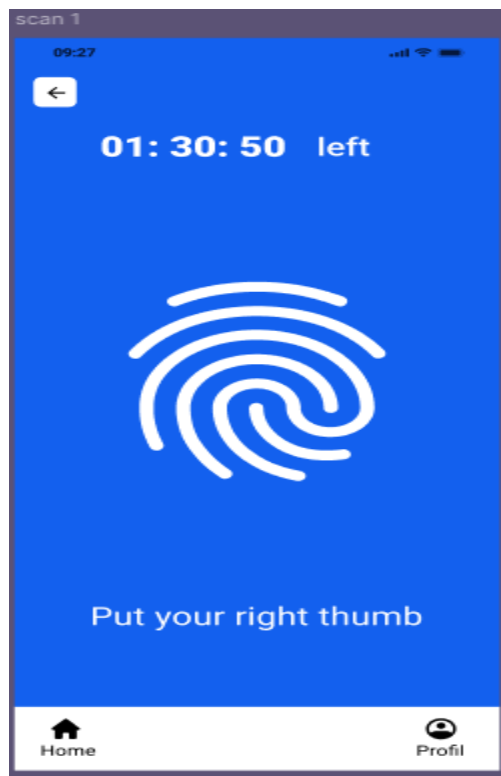
- Confirmation Message: Immediate feedback on successful or failed scans.
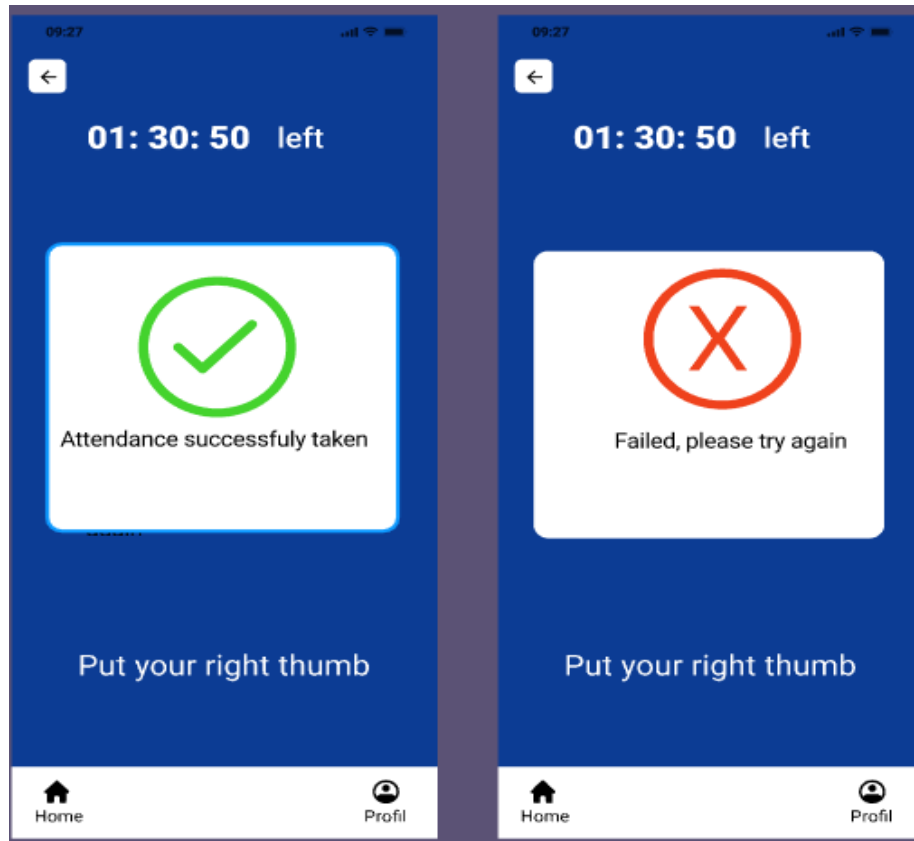
1.3.4. Attendance History

Purpose: Allows users to view their historical attendance records.

Features:

- Calendar View based on filters: Monthly calendar showing daily attendance status (use the filter option to show).

← **Attendance History** 🔔

Filters

📅 25-03-2024   10-06-2024

course ⌄

| M | Mathematics I | 09:30 am |
| | total of present **20/20** | |

| P | Physics | 10:40 am |
| | Total of present **10/20** | |

| B | Biology | 10:40 am |
| | Total of present **10/20** | |

| G | Geography | |
| | Total of present **10/20** | |

| C | Chemistry | |
| | Total of present **10/20** | |

| H | History | |
| | Total of present **10/20** | |

🏠 Home   👤 Profil

09:27   .ıl 📶 ▬

← **Attendance History** 🔔

Filters

📅 25-03-2034   10-06-2024

course ⌄

| M | Mathematics I | 09:30 am |
| | You are marked **present** | |

| P | Physics | 10:40 am |
| | You are marked **absent** by Faculty | |

| B | Biology | 10:40 am |
| | You are marked **present** | |

| G | Geography | |
| | You are marked **absent** by Faculty | |

| C | Chemistry | |
| | You are marked **present** | |

| H | History | |
| | You are marked **absent** by Faculty | |

🏠 Home   👤 Profil

09:27   .ıl 📶 ▬

← **view attendance** 🔔

Filters

📅 25-03-2024   10-06-2024

course ⌄

📄 **Dowload**

| **Tsapze Cinthai** | 09:30 am |
| FE21B238 | total of present **20/20** |

| **zambou Cinthai** | 09:30 am |
| FE21B238 | total of present **20/20** |

| **kene suzi** | 09:30 am |
| FE21B238 | total of present **20/20** |

| **aubin** | 09:30 am |
| FE21B238 | total of present **20/20** |

| **mariek djeunou** | 09:30 am |
| FE21B238 | total of present **20/20** |

| **Tsapze Cinthai** | 09:30 am |
| FE21B238 | total of present **20/20** |

🏠 Home   👤 Profil

09:27   .ıl 📶 ▬

← **view attendance** 🔔

Filters

📅 25-03-2024   10-06-2024

course ⌄

📄 **Dowload**

Total number of student: 54/70
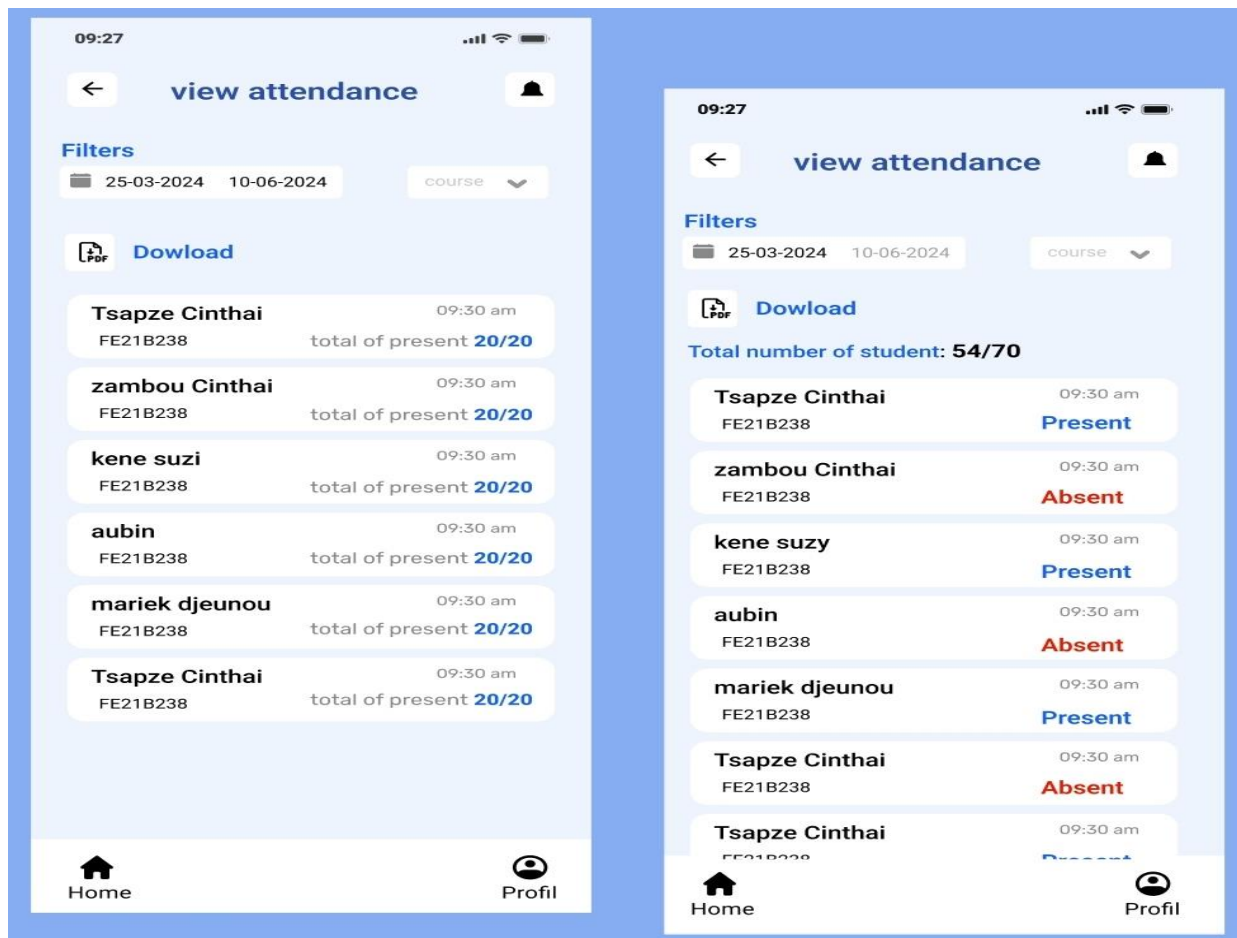
| **Tsapze Cinthai** | 09:30 am |
| FE21B238 | **Present** |

| **zambou Cinthai** | 09:30 am |
| FE21B238 | **Absent** |

| **kene suzy** | 09:30 am |
| FE21B238 | **Present** |

| **aubin** | 09:30 am |
| FE21B238 | **Absent** |

| **mariek djeunou** | 09:30 am |
| FE21B238 | **Present** |

| **Tsapze Cinthai** | 09:30 am |
| FE21B238 | **Absent** |

| **Tsapze Cinthai** | 09:30 am |
| FE21B238 | Present |

🏠 Home   👤 Profil

2. TECHNICAL IMPLEMENTATION

By doing a good implementation, our mobile application can provide a reliable, efficient and user-friendly experience.

2.1. System Architecture

The system architecture is the overview of the app's components and technologies used. It is designed to handle user interactions, biometric data processing, database management and secure communications. Here is a detailed look at the key components of the system architecture:

- **Client-Side**: The mobile application will be developed using the cross-platform framework React Native with TypeScript. This choice ensures a responsive and smooth user experience across both iOS and Android platforms.

- **Server-Side**: Backend services are built using Node.js with Express, providing a scalable and efficient way to handle API requests and business logic.

- **Database**: We will use MongoDB for its flexibility and scalability in handling unstructured data, making it ideal for managing user profiles, attendance records, and biometric data.

- **Authentication**: Firebase Authentication is integrated to manage user credentials securely and provide authentication services.

- **Biometric Integration**: The app uses the react-native-fingerprint-scanner library to access native biometric authentication capabilities on both iOS and Android devices.

2.2. UI Implementation Using Modern Frameworks and Libraries

- **Framework Choice**: React Native with TypeScript is used for its cross-platform capabilities and type safety, which help reduce runtime errors and improve code quality.

- **Component-Based Architecture**: Reusable UI components are created using libraries like React Native Elements, ensuring a consistent design and functionality across the app.

CONCLUSION

In conclusion, the design and implementation of the biometric student's attendance mobile application successfully integrate both aesthetic appeal and technical robustness. By adhering to key design principles, we ensured a user-friendly interface that promotes ease of use and efficient navigation. The strategic use of colors, such as blue for primary elements and green for confirmation messages, enhances the user experience by conveying trust, reliability, and positive feedback.The technical implementation leverages React Native for the frontend, providing a seamless and responsive user interface across different mobile platforms. MongoDB serves as the database, offering scalability and flexibility to manage the application's data efficiently. The backend, built with Node.js, ensures a reliable and performant server-side environment, capable of handling the application's requirements and integrating smoothly with the biometric authentication system.This comprehensive approach to both design and technical execution has resulted in a robust and intuitive biometric attendance application that meets the needs of students and administrators alike. The project's success demonstrates the effective combination of thoughtful UI design and solid technical foundations in creating a valuable educational tool.

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